

Klamath River Dam and Sediment Investigation

List of Future Studies

Studies Required	Discussion of Objectives and Products
Appraisal Level Investigation	
Dam Removal Study	This study is complete
Feasibility and Data Development	
<p>Sediment Characterization and Project Decommissioning Feasibility Study</p> <p>Provides overview of primary issues related to project decommissioning, discuss range of conceptual options for decommissioning, and illustrates a feasible approach</p>	<p>This work is contained in the <i>Klamath River Dam and Sediment Investigation</i></p>
<p>Marine</p> <ul style="list-style-type: none"> • Benthic mapping of the near shore environment • Quantify pre dam removal sediment budget entering estuary and marine environment • Characterize biology of near shore environment • Augment current long range radar installations with standard range installations in order to asses current littoral transport patterns 	<p>This series of studies will help quantify and characterize estuary and marine environment near the mouth of the Klamath River. Assessment of pre and post dam removal conditions is the objective of these studies.</p>

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<p>Hydrology</p> <ul style="list-style-type: none">• Assess hydrology of upper and lower river<ul style="list-style-type: none">○ Quantify tributary contributions	<p>This information would be used to determine the effects of dilution of TSS as it moves downstream. From this information a better understanding of the effects on water use can be developed. This study would also develop background levels of TSS that exist in the Klamath and other streams that contribute to the Klamath flow.</p>
<p>Biological Studies</p> <ul style="list-style-type: none">• Determine optimum timing of sediment release to avoid adverse effects on aquatic species• Define biological effects of sediment release.• Identify protective measures for aquatic species	<p>Initiation of drawing down reservoirs will increase downstream TSS. Biological studies would determine timing of critical fish runs, tolerance for elevated TSS, methods of avoidance of high TSS, invertebrate studies, and other protection measures that might be appropriate.</p>
<p>Geotechnical Investigation</p> <ul style="list-style-type: none">• Establish maximum reservoir drawdown rates• Select dam spoils sites	<p>An investigation of the stability of the land currently inundated and the areas immediately adjacent to the reservoirs would be conducted to determine the effects of various drawdown scenarios including reinundation effects, timing of initiation of drawdown, dam stability, and stability of sediment on upland slopes.</p> <p>Several of the locations considered for deposition of the material removed from dam structures are located on or near steep slopes. The stability of several spoils sites would be investigated.</p>

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<p>In Reservoir Sediment Behavior Studies</p> <ul style="list-style-type: none"> • Define geotechnical characteristics of uneroded sediment <ul style="list-style-type: none"> ○ Drainage rate ○ Consolidation rate surface loads ○ Volume shrinkage • Analyze of erosion behavior in reservoirs at 500 foot sections • Determine eroded width resulting from various flow regimes • Develop bank and overbank stabilization concepts 	<p>Several outstanding issues would be investigated in this study. The maximum rate of drawdown consistent with safety and downstream issues would be developed. The volume of sediment eroded would be determined based on drawdown rate, existing conditions in the reservoirs that might limit or contribute to sediment erosion, and the rate of erosion of material. In conjunction with biological and hydrological studies, the options for timing of initiation of the drawdown would be developed.</p> <p>Some further investigation of sediment characteristics may need to be conducted in this phase. Issues such as spatial distribution of sediment and in situ density may need more thorough development.</p> <p>This study would also review TSS based on different drawdown initiation times such as starting in June versus starting in October.</p> <p>Further analysis of reservoir sediment volume may be required if biological studies conclude TSS levels versus duration needs more development. Sonar investigation of sediment thickness in addition to probe analysis would help resolve volume issues.</p>
<p>Sediment Stabilization</p> <ul style="list-style-type: none"> • Develop stabilization alternatives <ul style="list-style-type: none"> ○ Revegetation ○ Mechanical stabilization 	<p>In conjunction with studies that develop options for initiation of drawdown, methods of stabilizing overbanks and reducing chronic erosion would be conducted.</p>

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<p>Sediment Transport</p> <ul style="list-style-type: none">• Review of Flooding and Downstream Sediment Transport resulting from Dam Removal.	<p>This study would investigate 1) the effects of erosion of coarse reservoir sediments downstream and 2) the effects of a new sediment regime downstream. Current reaches just below the dam are degraded from the effects of sediment starvation. These reaches would aggrade. Development after dam construction may be affected by higher flood elevations.</p>
<p>Structure and Outlet</p> <ul style="list-style-type: none">• Determine outlet gate requirements• Conduct stability analysis of embankment structures• Identify upstream and downstream structures	<p>Expensive outlet gates may be unnecessary at either Copco 1 or Iron Gate Dams for some drawdown rates and timing. Further investigation of Iron Gate Dam tunnel stability and capacity will also be required.</p> <p>Effects of reservoir removal on the state Highway 66 bridge will need to be investigated.</p> <p>Erosion and aggradation effects on downstream structures including the I-5 bridge over the Klamath will need to be investigated.</p>
<p>Energy and Economic Analyses</p> <ul style="list-style-type: none">• Quantify energy production value• Quantify fish and wildlife value	<p>The draft environmental impact statement for the project relicensing contains much of this information. In addition, California Energy Commission staff is conducting a review of project values. Future studies may also attempt to quantify fish and wildlife values and costs for transmission line upgrades.</p>

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Alternatives Analysis	
Evaluation of Dam Removal Alternatives Coordinated and Sediment Management Approaches	Based upon the results of the studies conducted in the Feasibility and Data Development process, all alternatives would be developed and results and effects of each approach compared. The number and extent of these studies would be dependent on conclusions derived from the previous studies.
Revegetation Alternatives	This study would investigate methods, timing, and effects of revegetating the currently submerged upland areas adjacent to the new river channel. Issues involve access timing required to plant and seed, appropriate methods of mechanical stabilization, and effects on surface erosion of plant types.
River Sediment Downstream Effects	This study would review the effects on downstream river morphology of the various dam removal alternatives.
Water Quality Protection Alternatives	This study would review the effects on downstream river and ground supplies affected by various dam removal alternatives, and would develop protection measures.
Biological Studies – Rescue/Rearing/Reintroduction	Would review the various options for protecting biological use of the river with the various dam removal alternatives.

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Environmental Impact Report/Statement Documents	
EIS and EIR	These documents would present the results of the previous studies and develop the needed social and environmental studies required.
Preliminary and Final Engineering Documents	
Preliminary Engineering	Based on the preferred alternatives developed in the EIR/EIS documents, preliminary engineering plans would be developed to further analyze costs and construction schedules.
Final Design and Contract Documents	This would develop the documents used to award a contract to complete dam removal and related construction projects.